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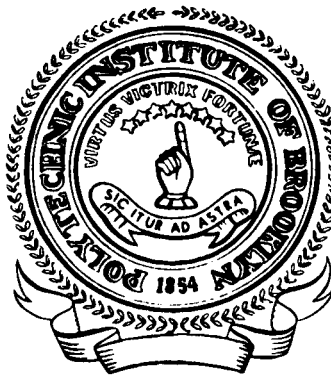
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FINAL REPORT

Grant No. NSG-165-61
Supplement No. 1-63

1 May 1962 to 30 April 1963



POLYTECHNIC INSTITUTE OF BROOKLYN

DEPARTMENT
of
AEROSPACE ENGINEERING
and
APPLIED MECHANICS

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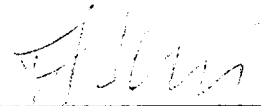
POLYTECHNIC INSTITUTE OF BROOKLYN

Department of Aerospace Engineering
and Applied Mechanics

Grant No. NsG-165-61
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1 May 1962 to 30 April 1963



Antonio Ferri
Director, Aerospace Institute

Final Report

National Aeronautics and Space Administration
Washington 25, D. C.

The following problems were investigated under the National Aeronautics and Space Administration Grant No. NsG-165-61, Supplement No. 1-63 entitled "Radiation Processes of Charged Particles Moving in the Upper Atmosphere, and Composition and Properties of the Magnetosphere":

1. Radiation from a rotating point charge.
2. Thermionic screening of hot objects in planetary atmospheres and interplanetary space.
3. Photoelectric screening of hot objects in interplanetary space.
4. Modification of the geomagnetic field by the magnetic moment of the Earth's radiation belts.

Item 1. Mr. Stanley Gianzero, under the supervision of Dr. M. Abele, has studied the problem of the spectral distribution of radiation emitted by a uniformly rotating point charge in a dispersive medium. A fully ionized gas in the presence of a magnetic field is an appropriate example of such a medium. The electromagnetic field quantities are determined from a linear solution of the Maxwell equations coupled with the fluid-dynamic equations for the fully ionized plasma. Both the non-relativistic and relativistic ranges of the test particle's velocity are considered. Particular attention has been paid to the case where the velocity of the point charge is of the same order of or larger than the phase velocity of the electromagnetic field in the medium. The results of this analysis are compared with those of the well-known Cerenkov radiation.

Item 2. The research under this item was carried out by Dr. K. P. Chopra in collaboration with Dr. C. S. Shen of the Institute for Space Studies, New York. Drs. Chopra and Shen considered problems which accompany thermionic emission of electrons from a hot body surrounded by a plasma. In the absence of other mechanisms, an electric potential is established at the surface of the body through the balance of thermionic emission and accretion of electrons from the external plasma. Analytical solutions are obtained for the electric potential field and the electron density distribution around the body. A possible application of this analysis to objects in space is indicated. This paper was presented at the annual meeting of the American Physical Society held in New York during January 1963. The abstract of the paper has been published in the Bulletin of the American Physical Society, Series II, Vol. 8, No. 1, p. 8, January (1963).

Item 3. Under the bombardment of photons in the ultraviolet and x-ray regions, objects in space may emit electrons and, hence, acquire an electric charge through the balance of the photoelectric emission from the surface and the accretion from the surrounding plasma. In the electric field of a positively charged body, many of the emitted photoelectrons describe ballistic orbits and return to the surface whereas some others escape. The escape component of the photoelectrons is replenished by the accretion of the surrounding plasma electrons. Analytical expressions are obtained for the electric potential field and the distribution of electron density around the body. Possible applications of this analysis to objects in space are also discussed.

The research reported under this item is also a product of the joint effort of Drs. Chopra and Shen. The results of this investigation were presented at the Spring meeting of the American Physical Society held in Washington, D. C. during April, 1963. An abstract has appeared in the Bulletin Amer. Phys. Soc., Vol. 8, Sr. II, No. 4, p. 305, April, 1963.

Item 4. The interaction between the magnetic field due to the ring current in the Earth's radiation belts and the geomagnetic field are being investigated by Dr. Chopra. The work is in progress.